PROJECT NUMBER : 0008
PROJECT TITLE : Computer Applications Division
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I. NEUROCOMPUTING

A. **Objective:** Develop programming techniques for use of the HNC ANZA Plus Neurocomputer and Multilayer Backpropagation Neurosoftware. Investigate potential applications of neurocomputing to R&D problems, and apply where appropriate.

B. **Results:** Research continues into improved backpropagation training of multilayer networks, as applied to the cigarette analyticals vs. liking score mapping problem. Several difficulties have been encountered recently. The main problem is that different mappings (predictions) are obtained depending on the random seed used for weight initialization, although the mean squared errors are approximately the same. Other problems include getting stuck in quasi-local minima and extremely long training times.

Research into these problems is proceeding along several fronts, including: (1) allowing a few chances for recovery after the mean squared error has increased, rather than immediately decreasing the step size, (2) batching over the entire training set in certain situations, and (3) improved algorithms for controlling the learning rate and momentum factor.

C. **Plans:** Continue research.

II. Expert Systems Development

A. **Objective:** Develop an Expert System for Cigarette Design.

B. **Results:** CigDES is built on top of two closely coupled subsystems: a mathematical cigarette model implemented and maintained in Fortran by Bill Dwyer and a model-based reasoning expert system implemented and maintained in Lisp and KEE by John Palesis. In view of the fact that the mathematical model is still evolving, it is necessary to establish a method whereby changes of this subsystem can be monitored and recorded so that they can be incorporated into the qualitative model and the model-based reasoning component of CigDES. We are presently studying how this can be accomplished with the UNIX System V Source Control System (SCCS). SCCS is a collection of UNIX system commands for controlling changes to files of text (storing and updating files, retrieving different versions, of files, recording who made each change and when it was made, etc.

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C. **Plans:** Updates of both the mathematical model Fortran files and the expert system Lisp files will be managed under SCCS.

D. **References:** Palesis, J.A., Dwyer, R.W., Leister, D.L., and Kao, J.W., "Transforming Mathematical Product Evaluation Models Into Expert Systems for Product Design," **Proceedings of the 3rd International Conference on Industrial & Engineering Applications of Artificial Intelligence and Expert Systems,** pp. 404-415, 1990.

III. Machine Learning

A. **Objective:** Apply AI-based machine learning in scientific research.

B. **Results:** We are presently using the machine induction tool **1st-Class** to analyze data collected in a hydromagnesite study conducted by Ken Podraza. The primary objective is to discover any existing correlations between the extinction coefficient (visible sidestream reduction), on the one hand, and, on the other, paper weight, porosity, sizing (type of organic salts), %cation (how much sodium, magnesium, potasium, etc. is in the paper), and Standard Burn Time.

We have also written a technical report titled **Machine Learning and Scientific Research: A Case for the ID3 Learning Algorithm./fR L2 "Plans" Present a technical seminar to demonstrate the use of the /fBID3/fR example-based learning algorithm in scientific research.**

C. **References:** (1) J. Palesis. **AI-Based Machine Learning and Scientific Research.** Memo to Colon Rowe, September 7, 1990. (2) J. Palesis. **Machine Learning and Scientific Research: A Case for the ID3 Learning Algorithm.** Technical Report, Philip Morris USA, December 21, 1990.

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